Production cross-sections of some radionuclides with therapeutic applications

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We have performed reaction model calculations to evaluate nuclear cross-sections of radionuclides with therapeutic applications, as part of a Coordinated Research Project sponsored by the International Atomic Energy Agency (IAEA). More specifically, we calculate the production cross-sections for the 90Y producing reactions, ^{89}Y(n,γ)^{90}Y and ^{90}Zr(n,p)^{90}Y, and the capture reactions ^{187}Re(n,γ)^{188}Re, ^{152}Sm(n,γ)^{153}Sm, ^{124}Xe(n,γ)^{125}Xe and ^{102}Pd(n,γ)^{103}Pd.

The calculations were performed using the computer codes EMPIRE-II, available at I.A.E.A., and TNG, from Oak Ridge National Laboratory (ORNL). The global spherical optical model of Koning and Delaroche was used for neutrons and protons and the McFadden-Satchler spherical optical potential was used for alphas. We analyse the various possible level density formalisms and make specific comparisons of the results of the two codes for all different cases. For high energies, the fully degenerate multistep compound emission of neutrons and protons and the multistep direct scattering of the incident neutron were taken into account. Different methods are used in TNG and EMPIRE-II to implement this multistep pre-equilibrium process, which makes this comparison particularly interesting to reveal the strengths and possible deficiencies of both codes. As far as possible, the level densities were adjusted to the available discrete states.

The calculations were compared to the experimental data available in the EXFOR library and with previous evaluations in the ENDF formatted libraries.

We have also evaluated unshielded spectrum averaged cross sections for the above reactions using the ENDF formatted libraries, which are discussed at the end of this work.

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